

ENERGY ENGINEERING ANALYSIS PROGRAM
(EEAP)
FORT SILL - LAWTON, OKLAHOMA

DISTRIBUTION STATEMENT E

Approved for public release;
Distribution Unlimited

EXECUTIVE SUMMARY
VOLUME I

1982

- VOLUME I: EXECUTIVE SUMMARY
- VOLUME II: ENERGY MONITORING AND CONTROL SYSTEM (EMCS)
- VOLUME III: EMCS POINT LIST
- VOLUME IV: ENERGY CONSERVATION OPPORTUNITIES
- VOLUME V: SITE SURVEY DATA
- VOLUME VI: PROGRAMMING DOCUMENTS
- VOLUME VII: IMPLEMENTATION DOCUMENTS

CONTRACT NO. DACA63-82-C-0173

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ENERGY MASTERS CORPORATION

13140 Coit Road Suite 409
Dallas, Texas 75240
214-669-8801

19971023 075




DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

REPLY TO
ATTENTION OF: TR-I Library

17 Sep 1997

Based on SOW, these Energy Studies are unclassified/unlimited.
Distribution A. Approved for public release.


Marie Wakefield,
Librarian Engineering

FINAL SUBMITTAL
TABLE OF CONTENTS

	PAGE
INTRODUCTION	1
VOLUME LISTING	1
PROJECT OVERVIEW	3
A. PURPOSE	3
B. BRIEF SCOPE OF WORK	3
METHODOLOGY	4
A. FIELD SURVEY	4
B. OFFICE ANALYSIS	5
C. UTILITY COSTS	7
SUMMARY AND RECOMMENDATIONS	11
PROJECT DEVELOPMENT	15
LIST OF BUILDINGS	19
RECOMMENDED ECOS	28
ENERGY PLAN	42

INTRODUCTION

This report is a final submittal for work performed under Contract No. DACA63-82-C-0173 Modification No. 4 consisting of an Energy Savings Opportunity Survey (ESOS) performed at Ft. Sill and including all buildings listed in Table I of this volume.

Fort Sill is a government owned and operated facility situated adjacent to the town of Lawton, Oklahoma. The facility was established under the Department of Defense and is operated as a US Army installation.

This report contains recommendations for the reduction of facility energy consumption in accordance with the U.S. Army's mission. The goal of this mission is to produce army facilities that operate as energy efficiently as possible while maintaining operational readiness.

A major portion of this report consists of a re-evaluation of a previous study involving the feasibility of installing an energy monitoring and control system (EMCS).

In addition to the EMCS re-evaluation, a low cost alternative to the EMCS, is presented along with supporting data and documentation.

The final major topic is the analysis and recommendations for energy conservation opportunities (ECOs) other than the EMCS and Low Cost Alternative. A summary of the recommended ECOs for all buildings is presented in Table 2 of this volume.

VOLUME LISTING

This report has been divided into 7 separately bound volumes. Due to the scope and magnitude of the EMCS, Volumes II and III have been devoted exclusively to this item. (Note: All offices are to receive complete copies of the entire report except the Tulsa District Office.) (Per Scope of Work, Annex B, Para. 2,B).

A. VOLUME I

Title: Executive Summary

Contents: Complete Project Summary

B. VOLUME II

Title: Energy Monitoring and Control System (EMCS)

- Contents:
1. Re-evaluation of the previous EMCS study performed by Carnahan-Thompson-Delano Inc. (dated February 1979) .
 2. Evaluation of a low cost alternative to the EMCS.

C. VOLUME III

Title: EMCS Point List

- Contents:
1. A matrix of each building recommended for the EMCS ECO. The matrix describes the type and location of sensor "points" required for each piece of monitored equipment.

D. VOLUME IV

Title: Energy Conservation Opportunities (ECOs)

- Contents:
1. Evaluation of each of this contracts ECOs with supporting calculations for each of the buildings surveyed.
 2. The appendix for the entire project including:
 - A. Minutes of Meetings
 - B. Scope of Contract
 - C. Building Data
 - D. Window Heat Gain Chart
 - E. Degree-Hour Chart and Weather Data

E. VOLUME V

Title: Site Survey Data

- Contents:
1. Data obtained during the site survey and used in the formulation of the project ECOs.

FORT SILL
CONTRACT NO. DACA63-82-C-0173

F. VOLUME VI

Title: Programming Documents (ECIP)

G. VOLUME VII

Title: Implementation Documents (NON-ECIP)

PROJECT OVERVIEW

A. PURPOSE

The purpose of this Energy Savings Opportunity Survey (ESOS) is to:

1. Review the previously completed energy studies accomplished for Fort Sill and re-evaluate projects recommended in these studies that have not been implemented.
2. Perform a limited site survey, evaluate the facilities with respect to selected Energy Conservation Opportunities (ECOs), and identify any other ECOs feasible for recommendation. The surveys will include both military family housing and non-family housing.
3. Update a previous Energy Monitoring and Control System (EMCS) feasibility study for building electrical mechanical and utility distribution systems.

B. BRIEF SCOPE OF WORK

The following outline is a brief description of work performed during the preparation of this report. The complete scope of work text (HNDED-PM/ME) as issued by the Corps of Engineers can be found in Volume IV.

1. Review for general information the previously completed EEAP studies.
2. Re-evaluate selected projects and ECOs from previous studies to determine their economic feasibility based on revised criteria, site conditions or technology.
3. Evaluate selected ECOs to determine their energy savings potential and economic feasibility.
4. Perform a limited site survey of selected buildings to insure that any new methods of energy conservation which are practical and have not been evaluated in any previous energy study have been considered.
5. Provide complete new programming or implementation documentation for all recommended ECOs.
6. Prepare a comprehensive report to document the work performed, the results and the recommendations.

METHODOLOGY

Initial work on this project began at our pre-negotiation meeting held with the U.S. Army Corps. of Engineers, Tulsa District on July 17, 1984. This meeting along with all subsequent meetings served to clarify and/or amend various items in the Scope of Work and update the Corps with progress reports as the work was completed.

A. FIELD SURVEY

Numerous field visits were made to the Ft. Sill facility during the ensuing two years in an effort to gather all information required to ensure adequate evaluation of our energy saving recommendations.

There are a total of 321 buildings included in this report. Many of these buildings are very similar in construction and equipment types. On the other hand, those buildings considered for EMCS evaluation are unique in construction and equipment types and require additional scrutiny. Since it was evident that all buildings could not be surveyed identically, we formulated three basic types of surveys and grouped all buildings accordingly. Each building and the type of survey performed is listed in the matrix contained in Table 2, Page 28 of this Volume.

1 LIMITED SITE SURVEY

This type of survey began with a careful analysis of construction plans and specifications. These were compared with the actual building construction and updated as required for accuracy. The overall objective was to identify potential energy saving recommendations using the ECOs listed in the Scope of Work as a basic guide. Special interest was given to those items "checked" in the Scope of Work matrix, (See Volume IV). Data, comments and notes for possible ECOs not listed in the matrix were also obtained.

In addition to the data gathered for the special interest items, the following observations were recorded:

- a.) The building operating schedules and current use.
- b.) The HVAC equipment type, location and general operating condition.
- c.) Building personnel were interviewed to identify potential ECOs and system problems.
- d.) Measured amps and voltage on major HVAC equipment including air handlers, pumps and chillers.

2. DETAILED SITE SURVEY

The data gathered and techniques used during this type of survey is similar to the limited site survey. Additional information was obtained in order to ascertain whether or not the building could be included in the proposed energy monitoring and control system. This additional information was obtained as outlined in "Preliminary Survey and Feasibility Study for Energy Monitoring and Control Systems" (Corps of Engineer Publication HNDSP-84-076-ED-ME Jan. 1984).

3. BRIEF VISIT

Many of the family housing buildings are similar in construction and mechanical system types. For these buildings, a limited site survey was performed at one of the buildings, and a one hour visit performed at the other typical buildings. This visit was to insure that all data and evaluations would be appropriate and recommendations would be accurate for all buildings of each type.

B. OFFICE ANALYSIS

After completion of the field survey portion of the project, a plan was developed for the final phase of the project which was performed at our Dallas Office. This phase was grouped into two major categories:

- 1. EMCS Re-evaluation
- 2. ECO Analysis

1. EMCS RE-EVALUATION (VOLUMES II AND III)

This consisted of re-evaluating an earlier EMCS study performed by Carnahan-Thompson-Delano Consulting Engineers titled "Energy Monitoring and Control System" dated February 23, 1979. In their study, they recommended that the proposed EMCS should serve 132 buildings.

It was decided after reviewing the previous study, that the best re-evaluation approach would be to start from "scratch" and examine each of the 132 buildings that were originally considered. Thus, each building was re-evaluated based on information obtained in our detailed site survey. The only information used from the previous EMCS study performed by Carnahan-Thompson-Delano were the design building heating and cooling loads.

Based on the field information, EMCS point lists and energy calculations were made for each building. Buildings were removed from consideration (based on individual building SIRs) until the overall EMCS project SIR was greater than 1.0. Those buildings that were eliminated from consideration were included in the FM Radio Controls for Non-Family Housing ECO. The EMCS Point List located in Volume III contains data for all 132 buildings instead of just the 40 buildings that were recommended. This was done so that information would be available for the evaluation of future building additions to the EMCS.

A low cost alternative for the EMCS was then considered as required in the Scope of Work. This involved providing FM Radio Controls and additional local controls in order to obtain the same energy savings that would be achieved with the proposed EMCS.

2. ECO ANALYSIS (VOLUME IV)

Analysis of this portion of the project included the remaining ECOs other than the above item and consisted of evaluating specific ECOs in buildings as shown on the matrix in Annex D of the Scope of Work as well as evaluating all other methods of energy conservation that may be appropriate.

Individual building ECOs were considered based on information obtained during the limited site survey.

ECOs that were considered infeasible were well documented in the report with reasons for elimination. ECOs recommended for implementation were described in the report. Detailed cost estimates, energy savings calculations, and economic analysis were prepared and included with each recommendation.

C. UTILITY COSTS

1. ELECTRICITY

The electrical energy cost increment which was used for energy saving calculations is shown in Figure 1 on the next page.

The cost was developed by taking the total amount paid for electricity over a 12 month period and dividing it by the total amount of electricity (Kwh) consumed over the same period. From this calculation, the average cost of electricity at Fort Sill was \$0.0357 per Kwh.

Using the conversion factor of 0.0116 Million Btu (Mbtu) per Kwh, a unit cost of electricity per million Btu was established. This calculated to be \$3.078 per Mbtu.

Due to the structure of Fort Sill's contract for electrical service, the demand charge is based on a minimum peak demand which has never been exceeded to date. Therefore, savings could not be considered for reducing Kw demand.

FIGURE 1.

FUEL RATE CALCULATION

<u>ELECTRICITY</u>	Agreed to take 12 month average utility rates	
	<u>KWH</u>	<u>CHARGE \$</u>
October 1983	4,851,387	181,930.47
November 1983	6,945,593	222,543.93
December 1983	5,982,777	200,573.03
January 1984	5,054,229	200,313.86
February 1984	4,665,278	185,181.70
March 1984	2,605,826	126,343.00
April 1984	6,058,514	221,656.04
May 1984	7,296,892	256,899.17
June 1984	7,229,027	260,620.13
July 1984	11,993,593	399,495.91
August 1984	9,763,861	337,855.03
September 1984	<u>9,432,714</u>	<u>328,522.41</u>
TOTALS	<u>81,879,691</u>	<u>\$ 2,921,934.68</u>

$$\frac{\$2,921,934.68}{81,879,691/\text{Kwh}} = \underline{0.0357 \text{ \$/Kwh}}$$

$$\frac{0.0357\$/\text{Kwh}}{0.0116 \text{ Mbtu/Kwh}_{(1)}} = \underline{3.078 \text{ \$/Mbtu}}$$

(1) From ECIP Guidance Department of the Army Letter DAEN-MPO-U.

2. NATURAL GAS

The natural gas energy cost increment which was used for energy saving calculations is shown in Figure 2 on the next page.

The cost was developed by taking the total amount paid for natural gas over a 12 month period and dividing it by the total amount(thousand cubic feet, Mcf) consumed over the same period. From this calculation, the average cost of natural gas at Fort Sill was \$4.73 per Mcf.

Using the conversion factor of 1.031 Million Btu(Mbtu) per Mcf a unit cost of natural gas per Mbtu was established. This calculated to be \$4.588 per Mbtu.

FIGURE 2.

FUEL RATE CALCULATION

NATURAL GAS

	MCF	CHARGE \$
December 1983	253,310	1,175,731.46
January 1984	223,586	1,069,366.02
February 1984	151,723	741,000.14
Marcy 1984	139,394	656,370.16
April 1984	77,182	371,701.02
May 1984	27,772	128,231.36
June 1984	27,993	128,279.99
July 1984	28,083	133,644.03
August 1984	27,545	129,225.61
September 1984	28,599	139,084.81
October 1984		
November 1984	<u>92,500</u>	<u>426,174.76</u>
11 MONTH TOTAL	<u>1,077,696</u>	<u>\$ 5,098,809.36</u>

$$\frac{\$5,098,809.36}{1,077,696 \text{ Mcf}} = \underline{4.73 \text{ \$/Mcf}}$$

$$\frac{4.73 \text{ \$/Mcf}}{1.031 \text{ MBtu/Mcf}}^1 = \underline{4.588 \text{ \$/MBtu}}$$

(1) From ECIP Guidance Department of the Army Letter DAEN-MPO-U

SUMMARY AND RECOMMENDATIONS

After carefully reviewing the previous energy study performed by Carnahan-Thompson-Delano, the following proposals are presented:

1. We recommend an Energy Monitoring and Control System (EMCS) be installed. This system will include only 40 of the 132 buildings originally recommended by the previous study and will save 71,881 MBTU(s) or \$260,266 annually at a construction cost of \$2,135,414 yielding a Savings to Investment Ratio (SIR) of 1.07 and 8.2 year simple payback.
2. The Low Cost Alternative recommendation to the above proposal will include the same 40 buildings and will save 71,881 MBtu(s) ✓ or \$260,266 at a construction cost of \$284,680 yielding a Savings to Investment Ratio (SIR) of 11.03 and 1.1 year simple payback.

The remaining Energy Conservation Opportunities that we are recommending for implementation are outlined in the ECO Summary on the following page. This portion represents an annual savings of 80,601 MBtu(s) or \$309,843 at a cost of \$1,030,873 yielding a 3.3 year simple payback.

The combined package of all ECOs recommended in this survey represents an annual savings of 152,116 MBtu(s) or \$570,064 at a cost of 3,166,287 (with EMCS) or 1,315,553 (Alternate).

The EMCS and Alternate to the EMCS are listed separately in the ECO summary since these two ECOs cannot be implemented simultaneously.

ECO SUMMARY
OCT 1986

ECO NO.	ECO DESCRIPTION	MBTU SAVING (GAS)	MBTU SAVING (ELEC)	MBTU SAVING TOTAL	TOTAL SAVING \$	TOTAL COST \$ FY87	SIR	SIMPLE PAY BACK
NON-FAMILY HOUSING								
10	EFFICIENT LIGHTING	0	139	139	428	188	22.40	0.4
21	DECENTRALIZE HW HTRS.	13104	702	13806	62278	82700	17.30	1.3
19A	FM RADIO CONTROL *	11716	20760	32476	117652	97925	14.80	0.8
23	REDUCE AIR FLOW	0	1056	1056	3251	3475	9.6	1.1
17	ECONOMIZER CYCLES	0	922	922	2837	4843	5.96	1.7
1	INSULATION	4081	247	4328	19479	109657	4.07	5.6
12	REPLACE INC. LIGHTING	0	561	561	4883	17800	3.42	3.6
33	VAV RETROFIT	0	1245	1245	3832	19600	1.99	5.1
31	HVAC ZONE CHANGES	168	84	252	1030	10925	1.92	10.6
32	CONDENSER CLEANERS	0	10395	10395	31994	182419	1.79	5.7
16	INFRARED HEATERS	2727	0	2727	12511	107424	1.74	8.6
7	DOOR SEALS	1940	0	1940	8901	84480	1.73	9.2
25	CHILLER REPLACEMENT	3240	(1462)	1778	10365	119700	1.5	11.5
3A	WEATHER STRIPPING	466	0	466	2136	22939	1.26	10.6
8	REDUCE GLASS AREA	311	185	496	1995	33376	1.24	16.7
4A	SOLAR FILM	0	996	996	3066	26576	1.06	8.7
FAMILY HOUSING								
19B	FM RADIO CONTROLS	0	3819	3819	11755	41475	2.88	3.5
3B	WEATHER STRIPPING	1062	0	1062	4872	24247	2.72	5.0
4B	SOLAR FILM	0	2137	2137	6578	41124	1.63	6.0
SUBTOTALS								
		38815	41772	80601	309843	1030873	---	3.3
ALTERNATE TO EMCS								
		25855	46026	71881	260266	284680	11.03	1.1
EMCS								
		25855	46026	71881	260266	2135414	1.07	8.2
TOTALS (With Alt)								
		64318	87798	152116	570064	1315553	---	2.3
TOTALS (With EMCS)								
		64318	87798	152116	570064	3166287	---	5.5

*NOTE: Central system cost excluded

**NOTE: This could change depending on the Alternate chosen for ECO 19; FM RADIO CONTROL

GENERAL COMMENT REGARDING RADIO CONTROLS

The FM Radio Control ECO appears in three different locations throughout this project:

1. Low Cost Alternative to the EMCS(VOL. II)
2. ECO #19A-FM Controls: Non-Family Housing(VOL. IV)
3. ECO #19B-FM Controls: Family Housing(VOL. IV)

There is no overlapping of buildings, savings or costs. The apparent redundancy results because part of the Low Cost Alternative to the EMCS happens to be a listed ECO(FM Controls). The cost for the central system further complicates the situation.

The central system includes the central processing unit, signal generator and miscellaneous hardware as well as programmed software. Only one central system is required to handle all buildings recommended under FM Radio Controls. The central system is a one time cost that allows the addition of new buildings to the system simply by adding the necessary field interface devices and local loop controls.

The problem of duplicating the central system costs arises in the consideration of the EMCS and the Low Cost Alternative. The following scenarios describe the reasoning used and the applications for FM Radio Controls in this report.

1. IF THE EMCS IS SELECTED: Radio Controls is not part of this proposal and the cost for a central control system has not been included. ECO #19A proposes a Radio Control System for buildings other than those 40 proposed for the EMCS and includes a cost for the central system.
2. IF THE LOW COST ALTERNATIVE IS SELECTED: The cost for a central control system has been included because Radio control is part of the Low Cost Alternative Proposal. In this recommendation, ECO #19A proposes a Radio Control System for buildings other than those 40 proposed for the alternative and includes a cost without the central system.

It was necessary to consider both possibilities during the Analysis of ECO #19A so that this recommendation could stand alone (regardless of which of the above scenarios were implemented) and to insure that the Central Radio Control System cost is not duplicated.

The following is a basic description of the scope of each ECO:

1. LOW COST ALTERNATIVE - This ECO is presented in Volume II - Energy Monitoring and Control Systems and includes only the 40 buildings recommended under the EMCS. The Radio Control System is a control method for start/stop and duty cycling energy savings only. The other energy savings under the alternate (i.e., Economizer Cycle, Hot and Chilled Water reset, Chiller Optimization, etc.) will be accomplished by local controls.
2. ECO #19A - FM CONTROLS (NON-FAMILY HOUSING)
This ECO is presented in Volume IV - Energy Conservation Opportunities and includes the remaining buildings initially recommended for the EMCS by the previous study. This ECO also includes 22 other Non-Family Housing Buildings. The analysis includes two cost estimates:
 1. A total cost with the Central Radio Control System so that these buildings could be grouped in a project with the EMCS.
 2. A total cost without the Central Radio Control System so that these buildings could be grouped in an alternate project with the low cost alternative.
3. ECO #19B - FM CONTROLS(FAMILY HOUSING)
This ECO is similar in function to the above ECO and is also presented in Volume IV. This recommendation includes 125 buildings and contains a cost without the Central Control System. It was decided that since the above items both contain a central system cost, an additional central system is not required. This ECO is not a "Stand Alone" recommendation.

FORT SILL

CONTRACT NO. DACA63-82-C-0173

PROJECT DEVELOPMENT

Each of the ECOs have been grouped into 7 major projects. All of the projects except No. 1 and 4 are groupings that can be implemented independently. Project 1 is an alternate to Project 4. (All costs are estimated through the first quarter of Fiscal Year 1987).

ECIP PROJECTS

● PROJECT 1: EMCS ALTERNATIVE; FUNDING ECIP

Items

- (1) EMCS Alternative (Fm Controls)
- (2) ECO #19A-FM Controls (Without Central System)

Total Request \$404,600

Total Annual Savings

Electricity (MBTU)	66,786	
Natural Gas (MBTU)	37,571	
Total (MBTU)	104,357	
Total Dollar Savings		\$377,918

Total SIR: 12.2

Total Payback(Years) 1.1

● PROJECT #2: IMPROVE CHILLER EFFICIENCY; FUNDING ECIP

Items

- (1) ECO #25 - Chiller Replacement
- (2) ECO #31 - HVAC Zone Modifications
- (3) ECO #32 - Condenser Tube Cleaners
- (4) ECO #33 - VAV Retrofit

Total Request \$ 350,900

Total Annual Savings

Electricity (MBTU)	10262	
Natural Gas (MBTU)	3408	
Total (MBTU)	<u>13670</u>	
Total Dollar Savings		\$ 47,221

Total SIR: 1.72
Total Payback (Years) 7.0

● PROJECT 3: BUILDING ENVELOPE ALTERATIONS; FUNDING ECIP

Items

- (1) ECO #1 - Insulation
- (2) ECO #3A - Weather Stripping
- (3) ECO #4A - Solar Film
- (4) ECO #7 - Large Door Seals
- (5) ECO #8 - Reduce Glass Area
- (6) ECO #16 - Infrared Heaters

Total Request \$ 405,500

Total Annual Savings

Electricity (MBTU)	1428	
Natural Gas (MBTU)	9525	
Total (MBTU)	<u>10953</u>	
Total Dollar Savings		\$ 48,096

Total SIR: 1.7
Total Payback: 8.9

0 PROJECT 4: EMCS: FUNDING ECIP

Items

- (1) Energy Monitoring and Control System (EMCS)
- (2) ECO #19A-FM Controls (With Central System)

Total Request \$2,409,000

Total Annual Savings

Electricity (MBTU)	66,786	
Natural Gas (MBTU)	37,571	
Total (MBTU)	<u>104,357</u>	
Total Dollar Saving		\$ 377,918

Total SIR 1.6

Total Payback(Years) 6.4

NON-ECIP PROJECTS

● PROJECT #1: DECENTRALIZE WATER HEATERS: FUNDING QRIP

<u>Item</u>	
(1)	ECO #21 - Decentralize Water Heaters
Total Request	\$ 82,700
Total Annual Savings	
Electricity (MBTU)	702
Natural Gas (MBTU)	<u>13,104</u>
Total (MBTU)	<u>13,806</u>
Total Dollar Savings	\$ 62,278
Total SIR: (QRIP Criteria)	7.2
Total Payback (Years)	1.32

● PROJECT #2: ECONOMIZER CYCLES FUNDING PECIP

<u>Item</u>	
(1)	ECO #17 - Economizer Cycles
Total Request	\$ 4,843
Total Annual Savings	
Electricity (MBTU)	922
Natural Gas (MBTU)	0
Total (MBTU)	922
Total Dollar Savings	\$ 2,837
Total SIR: (PECIP Criteria)	4.7
Total Payback:	1.7

● PROJECT #3: LIGHTING AND HVAC MODIFICATIONS; FUNDING PECIP

<u>Items</u>	
(1)	ECO #10 - Energy Efficient Lighting
(2)	ECO #12 - Replace Incandescent Lighting
(3)	ECO #23 - Reduce Air Flow
Total Request (FY 87)	
	\$ 21,463
Total Annual Savings	
Electricity (MBTU)	1,756
Natural Gas (MBTU)	0
Total (MBTU)	1,756
Total Dollar Savings	\$ 8,562
Total SIR:(PECIP Criteria)	3.8
Total Payback(Years)	2.5

● PROJECT #4: FM CONTROLS* FUNDING PECIP

<u>Items</u>	
(1)	ECO #19B - FM Controls (Family Housing)
Total Request (FY87)	
	\$ 41,475
Total Annual Savings	
	11,755
Electricity (MBTU)	3819
Natural Gas (MBTU)	-0-
Total (MBTU)	3819
Total Dollar Savings	\$ 11,755
Total SIR (PECIP Criteria)	2.3
Total Payback (Years)	3.5

FORT SILL
CONTRACT NO. DACA63-82-C-0173

● PROJECT #5: FAMILY HOUSING MODIFICATION: NO COST/LOW COST

Items

- (1) ECO 3B - Weather Stripping
- (2) ECO 4B - Solar Film

Total Construction Cost \$ 65,371

Total Annual Savings

Electricity 2137

Natural Gas 1062

Total 3199

Total Dollar Savings 11,450

Total Payback (Years) 5.7

Total SIR 1.9

TABLE 1

NON FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F.</u>	<u>CURRENT USE</u>
58	15,000	General Instruction
59	12,533	Applied Instruction
60	9,000	Applied Instruction
207	19,423	Admin. General Purpose
210	18,260	Admin. General Purpose
345	9,679	Museum
346	8,700	Museum
372	2,217	Religious Education
380	1,270	Religious Education
440	1,300	Nursery School
425	1,478	Post Chapel
438	10,607	Nursery School
441	11,990	Print Plant
442	13,589	Print Plant
443	17,231	Print Plant
445	386	Energy Plant
455	51,759	Post Headquarters
460	19,220	B.O.Q.
461	15,881	E.M. Barracks w/o Mess
462	35,285	Post Headquarters Bldg.
475	31,897	E.M. Barracks w/Mess
500	40,170	Officers Open Mess
605	18,360	Dental Clinic
635	17,648	B.O.Q.
652	21,191	Admin. General Purpose
700	146,599	General Instruction
701	19,372	Admin. General Purpose
707	77,010	General Instruction
730	208,360	General Instruction
741	7,010	Motor Repair Shop
745	5,712	Admin. General Purpose
746	5,712	Admin. General Purpose
750	34,901	Admin. General Purpose
755	6,409	Training Aids
756	5,712	Training Aids
758	5,712	Admin. General Purpose
759	5,600	Admin. General Purpose

TABLE 1
NON-FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F</u>	<u>CURRENT USE</u>
811	8,508	General Instruction
812	22,527	General Instruction
840	92,335	General Instruction
850	22,741	B.O.Q.
851	14,365	B.O.Q.
852	10,757	B.O.Q.
853	10,756	B.O.Q.
854	10,756	B.O.Q.
900	61,498	E.M. Barracks w/Mess
912	97,470	E.M. Barracks w/Mess
913	109,950	E.M. Barracks w/Mess
914	109,950	E.M. Barracks w/Mess
921	28,883	Gymnasium
922	9,913	Civ. Personnel
925	1,960	Heat Plant
930	11,022	Post Office Main Bldg.
935	31,992	Bowling Center
954	3,152	Motor Repair Shop
1490	60,150	Confinement Facility
1602	125,339	E.M. Barracks w/Mess
1603	116,567	E.M. Barracks w/Mess
1604	5,412	Group Headquarters
1605	21,925	E.M. Barracks
1606	21,529	E.M. Barracks
1607	22,888	E.M. Barracks
1611	4,091	RGT/BDE Headquarters
1614	23,247	E.M. Barracks
1615	19,769	E.M. Barracks
1616	21,589	E.M. Barracks
1640	33,120	Library
1645	13,240	Telephone Exchange
1651	15,999	Finance Admin.
1653	61,254	E.M. Barracks w/Mess
1655	61,493	Admin. General Purpose
1712	22,421	Post Exchange
1716	18,892	Post Exchange
1719	104,744	Commissary

TABLE 1
NON-FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F.</u>	<u>CURRENT USE</u>
1721	21,389	E.M. Service Club
1722	160	A.C. Plant
1950	19,676	Engineer Administration
2025	63,126	E.M. Barracks w/Mess
2250	18,270	Motor Repair Shop
2251	18,270	Motor Repair Shop
2252	18,270	Motor Repair Shop
2253	18,270	Motor Repair Shop
2254	18,270	Motor Repair Shop
2255	18,413	General Maintenance
2258	58,440	General Maintenance
2425	8,876	General Storehouse
2426	8,876	General Instruction
2427	8,876	General Storehouse
2428	41,817	E.M. Barracks w/o Mess
2429	41,817	E.M. Barracks w/o Mess
2430	8,832	Motor Repair Shop
2436	9,865	Administration Supply
2437	10,885	Enlisted Person Mess
2438	8,876	General Instruction
2440	8,876	General Storehouse
2442	12,562	Dental Clinic
2470	40,162	E.M. Barracks w/Mess
2471	40,162	E.M. Barracks w/Mess
2652	11,200	General Maintenance
2812	2,552	A.C. Plant
2840	10,435	Bn. Headquarters
2843	10,435	Bn. Headquarters
2916	1,380	Clinic
2933	Not Given	Theater
3040	131,859	General Instruction
3041	Not Given	Poolaw Hall
3161	6,587	Admin. General Purpose
3162	21,883	General Instruction
3164	21,883	General Instruction
3166	15,328	Admin. General Purpose
3168	6,384	Bn. Headquarters
3260	17,170	Theater
3281	27,705	E.M. Service Club

TABLE 1
NON-FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F.</u>	<u>CURRENT USE</u>
3410	2,577	Bn. Headquarters
3411	36,569	E.M. Barracks w/Mess
3412	36,569	E.M. Barracks w/o Mess
3413	26,569	E.M. Barracks w/o Mess
3414	36,569	E.M. Barracks w/o Mess
3415	36,569	E.M. Barracks w/Mess
3416	36,569	E.M. Barracks w/o Mess
3417	36,569	E.M. Barracks w/Mess
3418	36,569	E.M. Barracks w/o Mess
3419	36,569	E.M. Barracks w/Mess
3420	36,569	E.M. Barracks w/o Mess
3421	36,569	E.M. Barracks w/o Mess
3422	36,569	E.M. Barracks w/Mess
3423	36,569	E.M. Barracks w/o Mess
3424	36,569	E.M. Barracks w/Mess
3425	36,569	E.M. Barracks w/o Mess
3426	36,569	E.M. Barracks w/Mess
3427	36,569	E.M. Barracks w/o Mess
3428	36,569	E.M. Barracks w/Mess
3429	36,569	E.M. Barracks w/Mess
3430	36,569	E.M. Barracks w/Mess
3440	36,569	E.M. Barracks w/Mess
3442	2,016	A.C. Plant
3444	20,338	Gymnasium
3445	3,765	Dispensary w/o Beds
3541	3,563	General Storehouse
3559	9,350	General Instruction
3560	9,350	General
3601	23,414	E.M. Barracks w/o Mess
3608	9,350	General Instruction
3622	23,414	E.M. Barracks w/o Mess
3624	23,414	E.M. Barracks w/o Mess
3661	23,414	E.M. Barracks w/o Mess
3669	10,548	General Instruction
3682	23,414	E.M. Barracks w/o Mess
3684	23,414	E.M. Barracks w/o Mess
4070	2,750	Admin. General Purpose

TABLE 1

NON-FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.</u>	<u>CURRENT USE</u>
4533	1,460	Commissary
4700	197,134	Hospital
4701	6,281	A.C. Plant
4702	32,957	E.M. Barracks w/o Mess
4907	10,200	Tower
4908	39,914	Mnt. AC/HG ORG.
4915	40,121	Field Maintenance
4920	22,605	Flight Maintenance
4922	35,966	Field Maintenance
5020	7,002	Flight Simulator
5030	34,901	E.M. Barracks w/Mess
5033	12,478	Admin. General Purpose
5037	27,720	Balloon Hanger
5485	4,331	NCO Open Mess
5670	14,355	B.O.Q.
5671	14,365	B.O.Q.
5672	10,757	B.O.Q.
5673	10,756	B.O.Q.
5674	14,365	B.O.Q.
5675	14,365	B.O.Q.
5676	107,593	B.O.Q.
5678	124,000	B.O.Q.
5684	12,147	Officers Field Ration Mess
5685	21,888	B.O.Q.
5725	2,727	Officers Open Mess
5900	8,845	A.C. Plant
5925	20,000	Sewage Treatment Plant
6002	23,671	Admin. Support
6003	3,264	A/C Plant
6007	274,755	Trainee Barracks
6009	34,872	E.M. Barracks w/o Mess
6010	34,872	E.M. Barracks w/o Mess
6011	17,121	Enlisted Person Mess
6012	78,848	E.M. Barracks w/o Mess
6014	34,872	E.M. Barracks w/o Mess
6015	38,872	E.M. Barracks w/o Mess
6017	10,484	Btn Hq. & Cl. Room
6018	59,744	E.M. Barracks w/o Mess
6036	Not Given	New PX
6037	3,850	Dental Clinic
6050	274,755	Trainee Barracks
6120	16,000	Classroom
6130	20,000	Logistics

TABLE 1
FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F.</u>	<u>CURRENT USE</u>
305	4,366	Housing, CG-WO
311	2,064	Housing, CG-WO
321	1,247	Housing, NCO & Enl.
348	1,578	Housing, NCO & Enl.
351	2,064	Housing, EG-WO
361	2,635	Housing, NCO & Enl.
420	7,304	Housing, LC-MJ
422	6,732	Housing, General
423	5,727	Housing, General
513	11,629	Housing, LC-MJ.
514	11,629	Housing, LC-MJ
515	11,629	Housing, LC-MJ
516	11,629	Housing, LC-MJ
517	11,629	Housing, LC-MJ
518	3,457	Housing, LC-MJ
520	3,457	Housing, LC-MJ
523	11,629	Housing, LC-MJ
524	11,629	Housing, LC-MJ
528	4,565	Housing, Colonel
542	3,457	Housing, Colonel
620	11,629	Housing, LC-MJ
621	11,629	Housing, LC-MJ
622	11,629	Housing, LC-MJ
623	11,629	Housing, LC-MJ
624	11,629	Housing, LC-MJ
625	11,629	Housing, LC-MJ
626	11,629	Housing, LC-MJ
627	11,629	Housing, LC-MJ
628	11,629	Housing, LC-MJ
629	11,629	Housing, LC-MJ
630	11,629	Housing, LC-MJ
1100	2,421	Housing, LC-MJ
1105	1,517	Housing, Cape CG
1107	1,517	Housing, Cape CG
1108	1,442	Housing, Cape CG
1124	1,517	Housing, Cape CG
1125	2,826	Housing, Cape CG
1126	2,785	Housing, Cape CG
1127	1,517	Housing, Cape CG
1128	1,517	Housing, Cape CG

TABLE 1
FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F.</u>	<u>CURRENT USE</u>
1129	2,804	Housing, Cape CG
1131	2,844	Housing, Cape CG
1132	1,517	Housing, Cape CG
1133	2,826	Housing, Cape CG
1137	2,785	Housing, Cape CG
1140	2,844	Housing, Cape CG
1145	2,804	Housing, Cape CG
1201	2,944	Housing, LC-MJ
1202	1,429	Housing, LC-MJ
1204	1,429	Housing, LC-MJ
1206	2,944	Housing, LC-MJ
1230	1,429	Housing, LC-MJ
1300	12,068	Housing, LC-MJ
1301	6,526	Housing, LC-MJ
1303	6,750	Housing, LC-MJ
1304	4,618	Housing, Colonel
1310	4,959	Housing, General
1312	4,527	Housing, General
1320	12,161	Housing, LC-MJ
1820	2,366	Housing, NCO & E.M.
1823	2,064	Housing, NCO & E.M.
2045	4,365	Housing, NCO & E.M.
5062	2,064	Housing, NCO & E.M.
5075	4,107	Housing, LC-MJ
5078	4,565	Housing, Colonel
5425	2,612	Housing, NCO & Enl.
5426	2,912	Housing, NCO & Enl.
5427	2,612	Housing, NCO & Enl.
5428	2,912	Housing, NCO & Enl.
5429	2,779	Housing, NCO & Enl.
5432	2,779	Housing, NCO & Enl.
5433	2,612	Housing, NCO & Enl.
5503	15,419	Housing, NCO & Enl.
5504	2,574	Housing, Cape NCO
5505	2,727	Housing, Cape NCO
5506	2,574	Housing, Cape NCO
5508	2,574	Housing, Cape NCO
5509	2,727	Housing, Cape & NCO
5515	2,579	Housing, Cape & NCO
5517	2,579	Housing, Cape & NCO
5518	2,732	Housing, Cape & NCO

TABLE 1
FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F.</u>	<u>CURRENT USE</u>
5519	2,579	Housing, Cape & NCO
5737	2,918	Housing, NCO & Enl.
5747	2,779	Housing, NCO & Enl.
5752	2,918	Housing, NCO & Enl.
6501	1,129	Housing, ACWHCG-W
6502	1,247	Housing, ACWHCG-W
6503	1,129	Housing, ACWHCG-W
6504	1,247	Housing, ACWHCG-W
6505	1,310	Housing, ACWHCG-W
6506	1,154	Housing, ACWHCG-W
6507	1,353	Housing, ACWHCG-W
6508	1,245	Housing, ACWHCG-W
6509	1,353	Housing, ACWHCG-W
6510	1,154	Housing, ACWHCG-W
6513	1,297	Housing, ACWHCG-W
6514	1,247	Housing, ACWHCG-W
6517	1,297	Housing, ACWHCG-W
6518	1,247	Housing, ACWHCG-W
6520	1,247	Housing, ACWHCG-W
6521	1,178	Housing, ACWHCG-W
6522	1,297	Housing, ACWH, NCO, E
6525	1,178	Housing, ACWH, NCO, E
6527	1,129	Housing, ACWH, NCO, E
6529	1,178	Housing, ACWH, NCO, E
6541	1,154	Housing, ACWH, NCO, E
6543	1,127	Housing, ACWH, NCO, E
6546	1,245	Housing, ACWH, NCO, E
6547	1,127	Housing, ACWH, NCO, E
6550	1,245	Housing, ACWH, NCO, E
6551	1,127	Housing, ACWH, NCO, E
6552	1,353	Housing, ACWH, NCO, E
6562	1,245	Housing, ACWHCG-W
6564	1,154	Housing, ACWHCG-W
6565	1,245	Housing, ACWHCG-W
6566	1,127	Housing, ACWHCG-W
6567	1,154	Housing, ACWHCG-W
6569	1,847	Housing, ACWHCG

TABLE 1
FAMILY HOUSING

<u>BUILDING NO.</u>	<u>GROSS S.F.</u>	<u>CURRENT USE</u>
6570	2,173	Housing, ACWHCG
6571	2,266	Housing, ACWHCG-W
6573	2,061	Housing, ACWHCG
6575	1,900	Housing, ACWHCG-W
6576	1,981	Housing, ACWHCG
6603	2,158	Housing, ACWH NCO E
6605	2,492	Housing, ACWHCG-W
6608	2,620	Housing, ACWHCG
6704	1,965	Housing, ACWHCG

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY	DETAILED SURVEY	BRIEF SURVEY	RECOMMENDED FOR EMCS	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HWH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/AHU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY		
58		X		X	X		X	X			X																																				
59		X		X	X		X	X			X																																				
60				X	X		X	X																																							
207	X						X	X																																							
210	X						X	X				X																																			
345	X				X																																										
346	X				X																																										
372	X																																														
380	X																																														
425	X																																														
438		X		X				X																																							
440		X		X																																											
441	X										X																																				
442	X																																														
443	X																																														
445		X																																													
455		X					X	X																				X																			
460		X																																													
461	X											X										X	X																								
462		X		X	X			X																																							
475		X					X	X															X																								
500		X					X	X															X																								
605		X		X																																											

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY	DETAILED SURVEY	BRIEF SURVEY	RECOMMENDED FOR EMC'S	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HMW/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/ARU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTEHEAT RECOVERY						
635	X																																																		
652	X																																																		
700		X		X							X																	X																							
701	X							X													X															X															
707		X									X																																								
730		X									X												X														X														
741	X				X															X		X																													
745	X						X																																												
746	X						X																X																												
750		X																																																	
755	X						X	X															X																												
756	X						X																X																												
758	X						X																X																												
759	X																						X																												
811	X						X	X			X												X																												
812	X			X																																															
840		X									X				X								X															X													
850		X																																																	
851		X																																																	
852		X																																																	
853		X																																																	
854		X																																																	
900		X																					X																												

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY DETAILED SURVEY BRIEF SURVEY RECOMMENDED FOR EMCS	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HMH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXR	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/ARU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY
912	X																			X																						
913	X																			X																						
914	X																			X																						
921	X																			X																						
922	X																																									
925	X																																									
930	X																																									
933	X																																									
954	X			X				X												X																						
1490	X																			X																						
1602	X																			X																						
1603	X																			X																						
1604	X	X																																								
1605	X																			X																						
1606	X																			X																						
1607	X																			X																						
1611	X																																									
1614	X				X															X																						
1615	X				X															X																						
1616	X																			X																						
1640	X																																									
1645	X																																									
1651	X																			X																						

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY DETAILED SURVEY BRIEF SURVEY RECOMMENDED FOR EMC'S				(1) INSULATION (2) INSULATED GLASS (3) WEATHER STRIP/CAULK (4) SOLAR FILMS (5) ATTIC VENTING (6) VESTIBULES (7) LARGE DOOR SEALS (8) REDUCE GLASS AREA (9) SHUT HWH/MOD CONTROLS (10) ENERGY EFF LIGHTING (11) REDUCE LIGHT LVLS. (12) REPL INCAND LIGHTING (13) IMPROVE PF IN HVAC (14) INSTALL HI-EFF MOTORS (15) NIGHT SETBACK THERMOSTATS (16) INFRARED HEATERS (17) ECONOMIZER CYCLES (18) CONTROL HW CIRC PUMP (19) FM RADIO CONTROLS (20) RADIATOR CONTROLS (21) DECENTRALIZE HW HTRS (22) HEAT RECL (REFR GAS) (23) REDUCE HVAC AIR FLOW (24) REVISE BOILER CONTROLS (25) CHILLER REPLACEMENT (26) LOWER DOMESTIC HW TEMP (27) HEAT PUMPS HW/AC (28) WATER TREAT & SOFTEN (29) TRANSFORMERS (30) UPGRADE HVAC CONTROLS (31) HVAC ZONES/AREA EXH (32) CHILLER AUTO TUBE CLNG (33) CHANGE TO VAV SYST (34) INST HI-EFF RECIP COMPR (35) REPLACE EXIST CHILLERS (36) CENTRAL AC VS MULTI UNITS (37) SEPARATE AREA AC/ARU (38) CEILING FANS (39) AIR CURT 3 ENTRANCES (40) HVAC DACTING/DAMPERS (41) WASTE HEAT RECOVERY																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY DETAILED SURVEY BRIEF SURVEY RECOMMENDED FOR EMCs	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HW/HOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/ARU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY		
2437	X																																											
2438	X		X					X									X		X																									
2440	X		X					X									X		X																									
2442		X	X																																									
2470		X																		X																								
2471		X																		X																								
2652	X			X													X		X																									
2812		X																																X										
2840		X	X																																									
2843		X	X																																									
2916	X			X	X														X																									
2933	X			X																																								
3040		X	X																																									
3041	X																		X					X																				
3161		X	X																																									
3162		X	X																																									
3164		X	X																																									
3166		X	X																																									
3168		X	X																																									
3260		X	X																																									
3281		X	X	X	X																																							
3410	X			X																																								
3411		X																	X																									

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY	DETAILED SURVEY	BRIEF SURVEY	RECOMMENDED FOR EMCS	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HWH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/ARU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY		
3412		X																					X																								
3413		X																					X																								
3414		X																					X																								
3415		X																					X																								
3416		X					X																X																								
3417		X																					X																								
3418		X																					X																								
3419		X																					X																								
3420		X																					X																								
3421		X																					X																								
3422		X																					X																								
3423		X																					X																								
3424		X																					X																								
3425		X																					X																								
3426		X																					X																								
3427		X																					X																								
3428		X																					X																								
3429		X																					X																								
3430		X																					X																								
3440		X																					X																								
3442		X		X																																											
3444	X						X					X											X																								
3445	X											X																																			

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY	DETAILED SURVEY	BRIEF SURVEY	RECOMMENDED FOR EMC'S	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HWH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMP	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/HRU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY		
3541	X											X		X																																	
3559		X																																													
3560		X																																													
3601	X																X																														
3608		X																																													
3622	X																X																														
3624	X																X																														
3661	X																X																														
3669		X	X																																												
3682	X																X																														
3684	X																X																														
4070	X					X	X																X																								
4533	X																																														
4700		X	X																																												
4701		X																																													
4702		X																																													
4907		X																																													
4908		X																																													
4915		X	X																																												
4920		X																																													
4922		X																																													
5020		X	X																																												
5030		X						X															X																								

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY	DETAILED SURVEY	BRIEF SURVEY	RECOMMENDED FOR EMC'S	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SZALS	(8) REDUCE GLASS AREA	(9) SHUT HWH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/AHU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY					
5033	X					X					X																																							
5037	X																																																	
5485		X		X																										X																				
5670		X																																																
5671		X					X	X																																										
5672		X					X	X																																										
5673		X																																																
5674		X																																																
5675		X					X	X																																										
5676		X					X																X																											
5678		X					X																X																											
5684		X																																																
5685		X																																																
5725	X						X																X																											
5900		X																																																
5925		X																																																
6002	X						X																																											
6003		X		X																																														
6007		X																					X		X																									
6009		X																					X																											
6010		X																					X																											
6011		X		X																																														
6012		X																					X																											

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.					RECOMMENDED FOR EMC'S																																										
	LIMITED SURVEY	DETAILED SURVEY	BRIEF SURVEY		(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HWH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/ARU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY		
6014	X																						X																								
6015	X																						X																								
6017	X		X																																												
6018	X																						X																								
6036	X		X																																												
6037	X		X																																												
6050	X		X																																												
6120	X		X																																												
6130	X		X																																												
305	X					X	X																X																								
311	X					X	X																X																								
321	X					X	X																X																								
348	X					X	X																X																								
356	X					X	X																X																								
361	X					X	X																X																								
420	X					X	X																X																								
422		X				X	X																X																								
423	X					X	X																X																								
513	X					X	X																X																								
514		X				X	X																X																								
515		X				X	X																X																								
516		X				X	X																X																								
517		X				X	X																X																								

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY	DETAILED SURVEY	BRIEF SURVEY	RECOMMENDED FOR EMCS	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HWH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/AHU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY	
518	X					X																	X																							
520	X					X	X																X																							
523		X				X	X																X																							
524		X				X	X																X																							
528		X				X	X																X																							
542		X				X	X																X																							
620		X				X	X																X																							
621		X				X	X																X																							
622		X				X	X																X																							
623		X				X	X																X																							
624		X				X	X																X																							
625		X				X	X																X																							
626		X				X	X																X																							
627		X				X	X																X																							
628		X				X	X																X																							
629		X				X	X																X																							
630		X				X	X																X																							
1100	X					X	X																X																							
1105	X					X	X																X																							
1107		X				X	X																X																							
1108		X				X	X																X																							
1124	X					X																	X																							
1125						X	X																X																							

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	RECOMMENDED FOR EMCS																																										
	LIMITED SURVEY																																										
	DETAILED SURVEY																																										
	BRIEF SURVEY																																										
	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HW/HW/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PF IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/AHU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY		
1126			X	X															X																								
1127			X	X															X																								
1128			X	X															X																								
1129			X	X															X																								
1131			X	X															X																								
1132			X	X															X																								
1133			X	X															X																								
1137			X	X															X																								
1140			X	X															X																								
1145			X	X															X																								
1201	X			X	X														X																								
1202	X																		X																								
1204		X		X	X														X																								
1206		X		X	X														X																								
1230	X			X	X														X																								
1300	X			X	X														X																								
1301	X			X															X																								
1303		X		X	X														X																								
1304	X			X															X																								
1310		X		X	X														X																								
1312		X		X	X														X																								
1320		X		X	X														X																								
1820	X			X	X														X																								

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY DETAILED SURVEY BRIEF SURVEY RECOMMENDED FOR EMC'S				(1) INSULATION (2) INSULATED GLASS (3) WEATHER STRIP/CAULK (4) SOLAR FILMS (5) ATTIC VENTING (6) VESTIBULES (7) LARGE DOOR SEALS (8) REDUCE GLASS AREA (9) SHUT HWH/MOD CONTROLS (10) ENERGY EFF LIGHTING (11) REDUCE LIGHT LVLS. (12) REPL INCAND LIGHTING (13) IMPROVE PF IN HVAC (14) INSTALL HI-EFF MOTORS (15) NIGHT SETBACK THERMOSTATS (16) INFRARED HEATERS (17) ECONOMIZER CYCLES (18) CONTROL HW CIRC PUMP (19) FM RADIO CONTROLS (20) RADIATOR CONTROLS (21) DECENTRALIZE HW HTRS (22) HEAT RECL (REFR GAS) (23) REDUCE HVAC AIR FLOW (24) REVISE BOILER CONTROLS (25) CHILLER REPLACEMENT (26) LOWER DOMESTIC HW TEMP (27) HEAT PUMPS HW/AC (28) WATER TREAT & SOFTEN (29) TRANSFORMERS (30) UPGRADE HVAC CONTROLS (31) HVAC ZONES/AREA EXH (32) CHILLER AUTO TUBE CLNG (33) CHANGE TO VAV SYST (34) INST HI-EFF RECIP COMPR (35) REPLACE EXIST CHILLERS (36) CENTRAL AC VS MULTI UNITS (37) SEPARATE AREA AC/AHU (38) CEILING FANS (39) AIR CURT 3 ENTRANCES (40) HVAC DACTING/DAMPERS (41) WASTE HEAT RECOVERY																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	LIMITED SURVEY DETAILED SURVEY BRIEF SURVEY RECOMMENDED FOR EMC'S	(1) INSULATION	(2) INSULATED GLASS	(3) WEATHER STRIP/CAULK	(4) SOLAR FILMS	(5) ATTIC VENTING	(6) VESTIBULES	(7) LARGE DOOR SEALS	(8) REDUCE GLASS AREA	(9) SHUT HWH/MOD CONTROLS	(10) ENERGY EFF LIGHTING	(11) REDUCE LIGHT LVLS.	(12) REPL INCAND LIGHTING	(13) IMPROVE PP IN HVAC	(14) INSTALL HI-EFF MOTORS	(15) NIGHT SETBACK THERMOSTATS	(16) INFRARED HEATERS	(17) ECONOMIZER CYCLES	(18) CONTROL HW CIRC PUMP	(19) FM RADIO CONTROLS	(20) RADIATOR CONTROLS	(21) DECENTRALIZE HW HTRS	(22) HEAT RECL (REFR GAS)	(23) REDUCE HVAC AIR FLOW	(24) REVISE BOILER CONTROLS	(25) CHILLER REPLACEMENT	(26) LOWER DOMESTIC HW TEMP	(27) HEAT PUMPS HW/AC	(28) WATER TREAT & SOFTEN	(29) TRANSFORMERS	(30) UPGRADE HVAC CONTROLS	(31) HVAC ZONES/AREA EXH	(32) CHILLER AUTO TUBE CLNG	(33) CHANGE TO VAV SYST	(34) INST HI-EFF RECIP COMPR	(35) REPLACE EXIST CHILLERS	(36) CENTRAL AC VS MULTI UNITS	(37) SEPARATE AREA AC/AHU	(38) CEILING FANS	(39) AIR CURT 3 ENTRANCES	(40) HVAC DACTING/DAMPERS	(41) WASTE HEAT RECOVERY
5747		X		X	X														X																							
5752		X		X	X														X																							
6501	X			X	X														X																							
6502		X		X	X														X																							
6503		X		X	X														X																							
6504		X		X	X														X																							
6505		X		X	X														X																							
6506		X		X	X														X																							
6507		X		X	X														X																							
6508		X		X	X														X																							
6509		X		X	X														X																							
6510		X		X	X														X																							
6513		X		X	X														X																							
6514		X		X	X														X																							
6517		X		X	X														X																							
6518		X		X	X														X																							
6520		X		X	X														X																							
6521		X		X	X														X																							
6522		X		X	X														X																							
6525		X		X	X														X																							
6527		X		X	X														X																							
6529		X		X	X														X																							
6541		X		X	X														X																							

RECOMMENDED ECO'S

TABLE 2

BUILD. NO.	RECOMMENDED FOR EMCS																																								
	LIMITED SURVEY																																								
	DETAILED SURVEY																																								
	BRIEF SURVEY																																								
RECOMMENDED FOR EMCS																																									

ENERGY PLAN

The following basewide energy usage reductions includes Fort Sill and the Reserve Center.

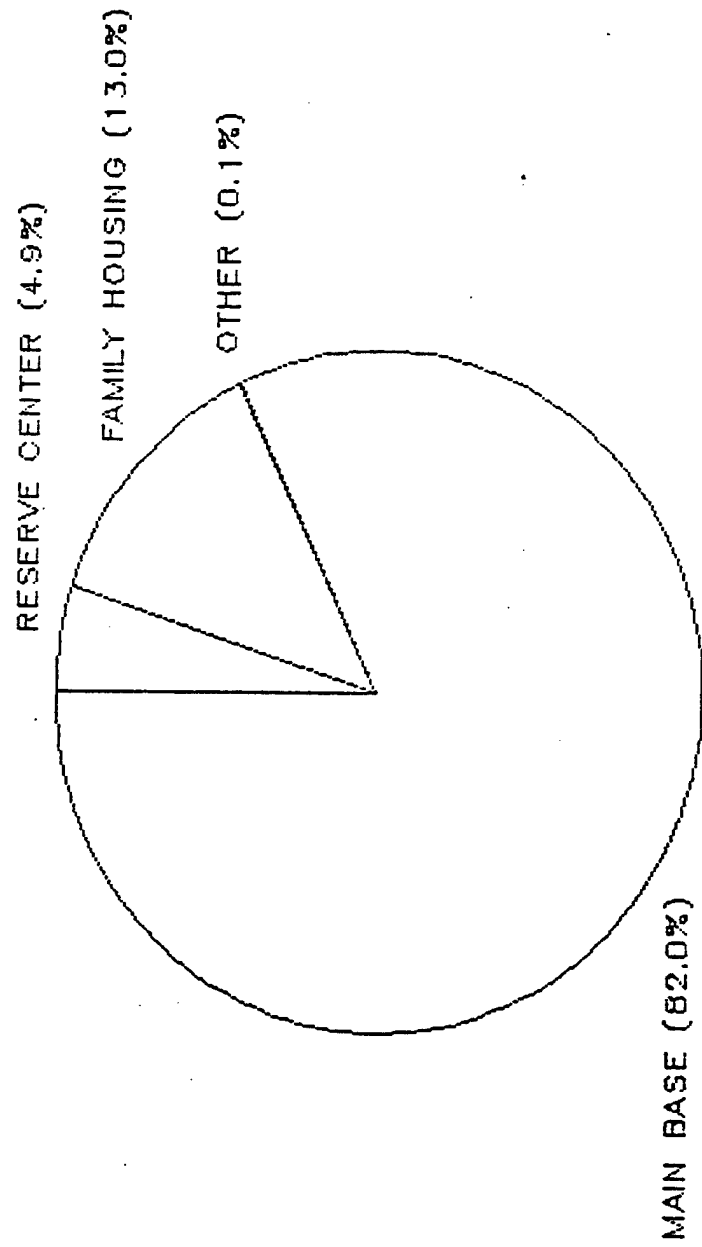
	<u>FY 1975(1)</u> <u>(Base Year)</u>	<u>FY 1986</u> <u>(Actual)</u>	<u>FY 1987(2)</u> <u>(Projected)</u>	<u>FY 1990(2)</u> <u>(Projected)</u>
Energy Use (Mbtu/Yr)	2,704,324	2,671,540	2,458,987	2,391,695
Active Building Area (square feet)	12,300,000	14,873,018	14,873,018	14,873,018
% Energy Reduction	-	1.2	9.1	11.6
Energy Usage Per square feet ₂ (KBtu/Yr/ft ²)	219.9	179.6	165.3	161

(1) From Ft. Sill EEAP Study, February 1984
Volume 1 - Executive Summary (pg 22)

(2) Includes Projects scheduled before the appropriate date.

ENERGY USAGE DISTRIBUTION (FY1986)

TOTAL CONSUMPTION = 2671540 MBTU



ENERGY USAGE PER FT2 (FT. SILL & RESERVE CTR.)

